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Running head : STEREOTYPE PRIMING AND SPATIAL PERCEPTION

Embodied perception with others' bodies in mind: Stereotype priming influence on the perception of spatial environment.

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Abstract

It has been shown that spatial perception is not only a function of optical variables but also a function of people's physiological potential. When this potential is reduced, either due to age or fatigue, individuals have been observed to report hills steeper and distances longer. Two studies have demonstrated that the experience of an actual reduction in capacities is not necessary. After being primed with the elderly category, young participants estimated the gradient of various pathways and that of a hill steeper (Study 1) and distances across a grassy field longer (Study 2) than their non-primed counterparts. The activation of a social category has often been found to result in stereotype-congruent behaviors. The present findings indicate that, in addition to this well-documented behavioral mimetism, this activation also leads to perceptual mimetism. I suggest that it helps facilitate social interactions by investing the partners with a shared vision of their environment.

Keywords: Spatial perception, Priming, Elderly stereotype

In addition to optical and ocular-motor information, the visual perception of our environment is influenced by nonvisual factors such as our bodies' behavioral abilities and the energetic costs associated with anticipated actions in the perceived environment. Hills appear steeper to observers who are elderly and in declining health than to observers who are young and healthy; hills also appear steeper to observers when they are tired or carrying a heavy backpack; and the distance to a target appears greater to observers when they are carrying a heavy backpack or have to throw a heavy ball (Bhalla & Proffit, 1999; Proffitt, Bhalla, Gossweiler, & Midgett, 1995; Proffitt, Creem, & Zosh, 2001; Proffitt, Stefanucci, Banton, & Epstein, 2003; Witt, Proffitt, & Epstein, 2004). Thus, a constant finding across all these studies is that gradients and distances appear greater as observers' physiological potential is reduced (Proffitt, 2006). As Proffitt has claimed (2006), such distortions of the apparent geometry of the environment may play a functional role: before climbing a hill, people do not need to estimate the energetic costs of their action if these are directly apparent in the configuration of the environment. By making these energetic costs apparent, visual perception informs people's decisions (choice of a locomotor speed, for example) and consequently contributes to action planning. More generally, these distortions illustrate the notion, already evident throughout Gibson's (1979) ecological approach, that visual perception is embodied and action centered.

I conducted two studies to investigate the influence of stereotype priming on the perception of gradients and distances which might result from unconscious changes in observers' perceived physiological potential. Much research has already demonstrated that a stereotype (i.e., characteristics believed to be true for members of a given social category) can be activated spontaneously from memory through simple exposure to relevant stimulus cues in the environment and may subsequently influence individuals' behavior in a stereotype-congruent manner (see Dijksterhuis & Bargh, 2001; Wheeler & Petty, 2001, for reviews). For example, young individuals exposed to words strongly associated with elderly people (e.g., *wrinkle, bingo, retired*) walked more slowly when leaving the laboratory than young individuals exposed to control words (Bargh, Chen, & Burrows, 1996). More recently, the performances of sports students required to throw a heavy ball decreased after repeated exposure to the label *"elderly people"*, whereas the performances of other sport students repeatedly exposed to the label *"basketball player"* improved (Follenfant, Légal, Marie Dit Dinard, & Meyer, 2005). In addition, and whatever the nature of the behavior (e.g., motor action, intellectual performance, social behavior), researchers have consistently noted that these effects occur automatically, i.e. they are outside of the individual’s control and awareness of the activation of the stereotype and its subsequent influence.

In an attempt to account for this wide range of automatic behavioral effects, Wheeler, DeMaree, and Petty (2005; 2007) suggest that traits from the primed social category become integrated in the perceiver’s working self-concept. Insofar as the working self-concept generally plays a role in guiding behavior, these momentary alterations in self-perceptions could then lead to the observed behavioral effects. In support of their Active-Self account, the authors report growing evidence that stereotype priming induces significant changes in self-perceptions, as well in many other self-relevant aspects such as attitudes, feelings, or self-esteem.

Given that young people's stereotype of the elderly includes poor health and declining capacities (e.g., Hummert, Garstka, Shaner, & Strahm, 1994), I hypothesized that young adults primed with the elderly category would estimate hills to be steeper and distances to be longer than non-primed young adults due to expected stereotype-congruent changes in perceptions of their current state of fatigue, wealth status, or physical fitness. The first study took place in a public park and the second in a grassy field on the campus. In both studies, the participants were primed with the elderly category using Bargh et al's. (1996) sentence-unscrambling procedure. The participants then had to estimate the gradient of various pathways and of a grassy hill in the park (Study 1), or the distance from themselves to a cone placed on the field (Study 2).

The objective of the present research is twofold. The first goal is to show that, because of its embodied nature, visual perception may be susceptible to the subtle influence of environmental cues responsible for non-volontary and non-conscious alterations of self-perceptions. The second goal is to establish that stereotype priming not only influences people's behaviors, but also influences their perception of the natural environment in which these behaviors take place.

STUDY 1: PERCEPTION OF SLOPES

Method

Participants

Forty students (20 men and 20 women; age range = 18-25 years) participated in the study. They were stopped individually on their way through a hilly park near the campus in Clermont-Ferrand and asked whether they would like to participate in two experiments.

Procedure

The study consisted of two parts presented as two unrelated experiments and run by two different experimenters in order to avoid providing an insight into the real purpose of the research. The first part was modeled on the paradigm developed by Bargh et al. (1996) to prime the elderly stereotype. The participants were asked to unscramble 25 six-word sentences by dropping an extraneous word from each to create a grammatical five-word sentence. In the elderly prime condition, 20 of the 25 sentences included a word identified in a pre-study as being strongly associated with the elderly category (e.g., *retired, solitude, moaning, wisdom*). Any direct reference to fatigue or reduction in physiological potential was excluded. In the no-prime condition, neutral sentences were used. The participants were randomly assigned to a condition.

In the second part, the participants accompanied the second experimenter to the foot of a straight, sloped section of four different pathways (4°, 5°, 6°, and 7° incline respectively) and the bottom of a grassy hill (17° incline). All the sections and the hill had a fairly uniform and even surface and were located in a limited area. The participants were asked to state their estimate of the gradient of the pathway or hill as a number of degrees. The slopes were presented in random order. The experimenter was unaware of the condition to which the participants were assigned.

The experimenter questioned the participants about the tasks and their hypothetical relatedness using the funneled debriefing procedure described by Bargh and Chartrand (2000). None of the students identified the theme of elderly people among the words in the priming task. Only two of them identified a particular but irrelevant theme. None of them indicated any suspicion of a connection between the two parts of the study and of a possible influence of the first task on the second. Finally, the participants were debriefed and thanked.

Results and discussion

As in most research on slope perception, the participants overestimated the steepness of the hill (17° incline) ($M = 33.4°$), one-sample $t(39) = 6.87$, $p < .001$. More important, priming modulated this overestimation. As expected, priming with the elderly stereotype produced a significant increase in estimates (control: $M = 24.7°$; stereotype: $M = 42.1°$), $F(1, 39) = 19.92$, $p = .001$.

The same pattern of results was found for the perception of the pathways. Overall, the participants overestimated ($M = 12.6°$) the steepness of the pathways ($M = 5.5°$ incline), one-sample $t(39) = 6.19$, $p < .001$. Again, this overestimation was modulated by priming (control: $M = 9.6°$; stereotype: $M = 15.65°$), $F(1, 39) = 8.18$, $p < .01$. A 2 (priming) X 4 (pathway) repeated measures analysis of variance was performed, with priming as the between-subjects variable and pathway as the within-subjects variable. This analysis revealed a main effect of pathway, $F(3, 114) = 40.19$, $p < .001$, and confirmed the main effect of priming, $F(1, 38) = 8.18$, $p < .01$. However, these two effects were qualified by a significant priming X pathway interaction, $F(3, 114) = 4.70$, $p < .01$. In order to further examine this interaction, polynomial contrasts were computed. They revealed a significant linear trend, $F(1, 38) = 6.88$, $p < .02$, indicating that the effect of stereotype priming on perceived steepness increased in a linear manner as the gradient of the pathway increased (see Figure 1).

These findings provide evidence that the implicit priming of the elderly stereotype produces dramatic changes in spatial perception: primed participants consistently judged pathways and a hill to be significantly steeper than non-primed participants did. Interestingly, the largest changes occurred when the participants estimated the steepest pathways.

STUDY 2: PERCEPTION OF DISTANCES

Method

Participants

Forty students (20 men and 20 women; age range = 18-25 years) were recruited at Blaise Pascal University. After being told they would participate in two unrelated experiments, they were individually accompanied to a flat, grassy field on the campus.

Procedure

The procedure was the same as in Study 1, the only difference being that the participants estimated distances instead of gradients. The participants were randomly assigned to either the priming or the neutral condition.

The distance estimation task replicated the task designed by Proffitt et al. (2003; Exp. 1). The students were given a 1m ruler as a scale reference and had to verbally estimate the distance (in meters) from themselves to a small orange cone placed on the field. Golf tees were used to help in the placement of the cone at different distances ranging from 1 to 17 m from the participant. Placed flush with the ground, the tees were invisible to the participant. Six rows of tees were arranged in a radial pattern, with the participant standing at their point of convergence. Each participant made 24 distance estimates (two blocks of 6 practice trials and two blocks of 6 test trials). The practice distances ranged from 1 to 17 m and, in each of the test blocks, the distance trial values were 4, 6, 8, 10, 12, and 14 m. The distance presentation order within blocks was randomized. The row on which the cone was presented was also randomized.

The funneled debriefing procedure indicated that none of the students identified either the theme of elderly people or any particular theme among the words in the priming task. None of them indicated any suspicion of a connection between the two parts of the study. Finally, the participants were debriefed and thanked.

Results and discussion

As Figure 2 shows, the participants in the control condition underestimated the actual distances from themselves to the cone (M = 8.01 m; actual M = 9 m), one-sample $t(19) = -3.75$, $p < .001$. This result is consistent with previous research demonstrating a compression of perceived space for distances greater than about 3 m (e.g., Cook, 1978; Norman, Todd, Perotti, & Tittle, 1996). Overall, the participants primed with the elderly stereotype judged the distances to be longer than the control participants did (control: M = 8.01 m; stereotype: M = 9.96 m), thus accurately estimating the smaller distances (between 4 and 8 m) and overestimating the larger ones.

A 2 (priming) X 2 (block) X 6 (distance) repeated measures analysis of variance was performed, with priming as the between-subjects variable and block and distance as the within-subjects variables. This analysis showed a main effect of priming, $F(1, 38) = 5.96$, $p < .02$, a main effect of distance, $F(5, 190) = 120.61$, $p < .001$, and a significant priming X distance interaction, $F(5, 190) = 3.30$, $p < .01$. Polynomial contrasts revealed a marginally reliable linear trend, indicating that the effect of stereotype priming tended to increase as the estimated distance increased, $F(1, 38) = 3.77$, $p = .06$.

As hypothesized, elderly stereotype priming modified the participants' perception of their physical environment, leading them to judge distances as significantly greater than non-primed participants. Moreover, this effect appeared to be larger as the distances increased and thus reflects the pattern of results obtained in Study 1. This unexpected interaction could be explained by the fact that the changes in perceived self-potential induced by elderly priming become more relevant as the distances, or the hills, become more effort demanding.

Means and standard deviations are reported in Table 1 and Table 2. Large standards deviations indicate a weak consensus among the participants. This high variability between individuals can be caused by numerous factors, like differences in personal experience, difference in personal standards of reference, the task difficulty, or the magnitude of the estimated distance or slant. In order to control for the magnitude effect, a ratio was computed, relating the standard deviation divided by the mean estimated angle or distance. The examination of the ratio values shows that the standard deviation remains proportionally constant whatever the estimated distance is (Table 2). Higher values are found in the case of angle estimations (Table 1). This is probably due to the fact that participants were less precise in their verbal responses, systematically using integers when reporting gradients (e.g., 2°; 5°) whereas frequently using decimals when reporting distances (e.g., 2.50 m; 4.70 m). Overall, the standard deviations appear not to be proportionally larger in the case of large angles or long distances than in the case of small angles or short distances. Insofar as the standard deviation is considered as an index of how difficult an estimation is, this result suggests that differences in task difficulty cannot account for the greater priming effects observed in the case of larger angles and longer distances.

GENERAL DISCUSSION

These two studies examined the perception of the ground in its two principal dimensions: orientation and extent. The results indicated that stereotype priming greatly alters this perception: young adults primed with the elderly category estimated slopes as steeper and distances longer than their non-primed counterparts. Previous research has revealed perceptual modifications of space when the participants' physiological potential is reduced by age, poor health, an hour's jogging or a heavy backpack. The present findings further demonstrate that the participants do not have to experience a genuine reduction in their own physiological capacity. Implicitly induced changes in their perceived potential are sufficient to provoke similar effects on spatial perception. Thus, stereotype priming must be considered in addition to other recently observed subtle influences on the perception of natural environments, such as psychological regulation motives (Balcetis & Dunning, 2007) or psychosocial resources (Schnall, Harber, Stefanucci, & Proffitt, 2008).

The issue of how the activation of a social category generates changes in the self-perceptions can be addressed at least in two ways. The first one is to regard these changes as a consequence of phenomenons of a semantic nature. For example, Wheeler, DeMaree, and Petty (2005; 2007) suggested a possible cognitive bias by which the traits associated with the social category, when activated and then made highly accessible, could be falsely taken for descriptive of the self. The second way is to consider these changes as a consequence of phenomenons of a mimetic nature. For example, embodiment theories state that activating knowledge about a social category leads to a simulation of the bodily states associated with the category (for a review, see Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005). Accordingly, thinking about other people consists in reexperiencing others' bodies in one's self. Mirror neurons are often evoked to support such a simulation at a neuroanatomic level (e.g., Gallese, 2005).

The present findings also shed new light on previous research into the automatic effects of stereotype priming on behavior (e.g., Bargh et al., 1996; Follenfant et al., 2005). They show that stereotype priming not only influences people's behavior, but also their perception of the spatial environment in which this behavior takes place. Insofar as the function of spatial perception is to help people to plan their future and intentional actions (Proffitt, 2006), the present findings suggest that stereotype priming effects on behavior could be mediated by changes in the perception of the environment and the impact of these changes on the planning of action and pre-motor decisions (for example, locomotor speed selection and energetic resource allocation).

Elderly people are viewed as being in poor health. They are also believed to think and move slowly. In line with this stereotype, the activation of the elderly category has also been found to affect young participants' perception of time (Chambon, Droit-Volet, & Niedenthal, 2008). Together, these results indicate that being exposed to a social category or its members leads people to a very different experience of their ambient world, both in its spatial and temporal aspects. One possibility is to consider these effects to be misleading, as the undesirable consequence of exposure to situational cues irrelevant to spatial and temporal perception. A more intriguing approach is to consider that they might play a functional role. Bargh and colleagues (Bargh et al., 1996; Dijksterhuis & Bargh, 2001) interpreted the automatic assimilation of stereotypes observed in primed participants' behavior as an empathic reaction, able to harmonize the thinking of and facilitate interactions between partners from different social categories. I suggest that, in addition to behavioral mimetism, the perceptual mimetism engendered by stereotype priming could also facilitate social interactions by providing partners with a shared vision of their environment.

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Authors note

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Table 1

Mean estimated angle and standard deviation as a function of true slant and of priming condition.

	Actual angle (°)				
	4	5	6	7	17
Control					
M	6.40	8.20	10.25	13.55	24.65
SD	4.75	6.59	7.99	8.89	9.77
*Ratio**	*0.7*	*0.8*	*0.8*	*0.7*	*0.4*
Stereotype					
M	8.70	13.15	17.45	23.30	42.10
SD	5.28	6.44	9.45	10.93	14.51
*Ratio**	*0.6*	*0.5*	*0.5*	*0.5*	*0.3*

* Ratio = standard deviation divided by mean estimated angle.

Table 2

Mean estimated distance and standard deviation as a function of actual distance and of priming condition.

	Actual distance (m)					
	4	6	8	10	12	14
Control						
M	3.56	5.18	6.80	8.87	10.61	13.05
SD	0.81	0.82	1.10	1.43	1.73	2.66
*Ratio**	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*
Stereotype						
M	3.88	5.87	8.04	11.34	13.92	16.69
SD	1.12	1.74	2.07	4.90	5.63	7.50
*Ratio**	*0.3*	*0.3*	*0.3*	*0.4*	*0.4*	*0.4*

* Ratio = standard deviation divided by mean estimated distance.

Figure Captions

Figure 1. Perceived gradient (± 1 SE) as a function of true pathway gradient and priming condition.

Figure 2. Perceived distance (± 1 SE) as a function of true distance and priming condition.

Figure 1

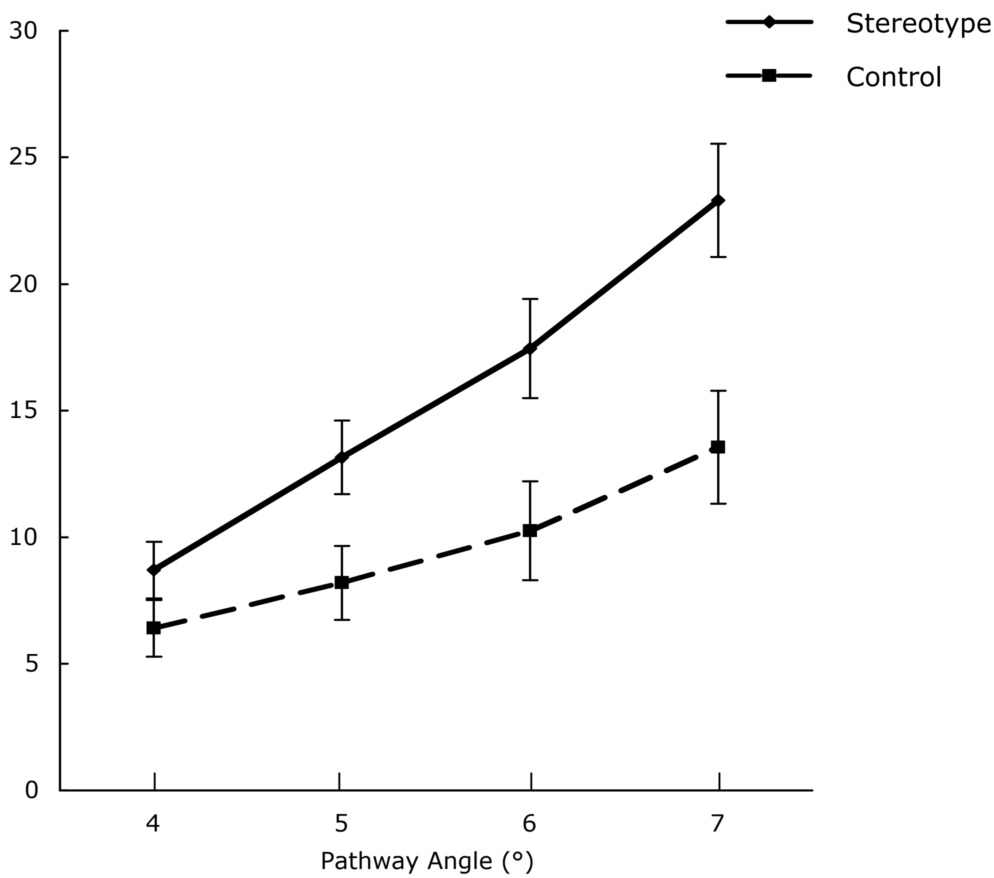
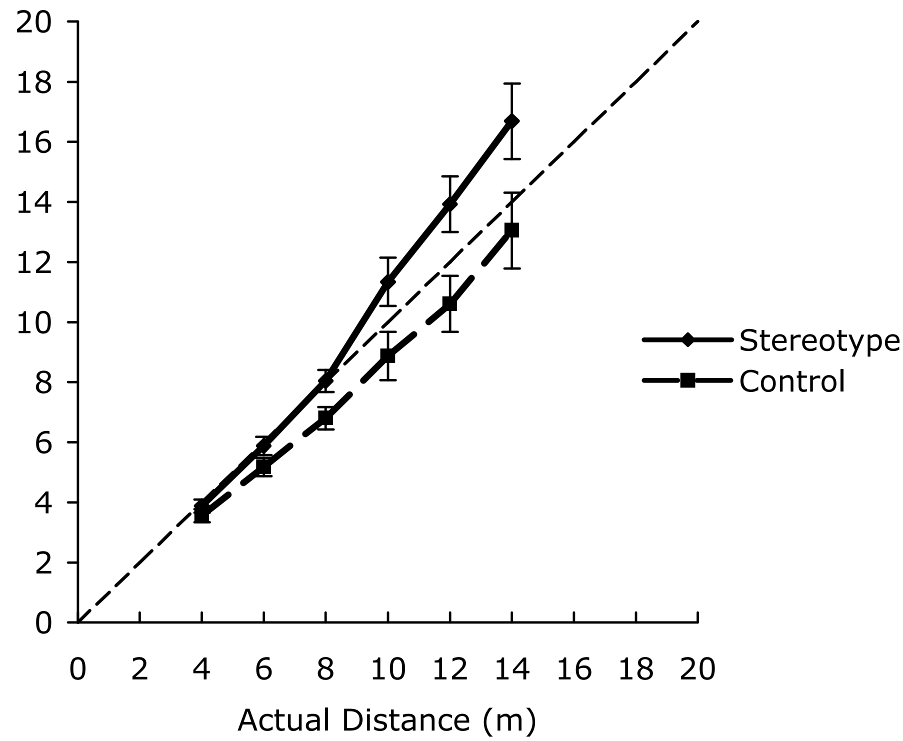


Figure 2


20
18
16
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Actual Distance (m)
Stereotype
Control